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भारतीय मानक

भूकृत्रिम — सुरक्षा (अथवा कुशनिंग) हेतू भूवस्त्रादि
सामग्री — विशिष्टि

Indian Standard

GEO-SYNTHETICS — GEO-TEXTILES USED
AS PROTECTION (OR CUSHIONING)
MATERIALS — SPECIFICATION

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BUREAU OF INDIAN STANDARDS
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Price Group 2

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geo-synthetics Sectional Committee had been approved by the Textile Division Council.

Most solid and hazardous waste landfills, lagoons and reservoirs built today incorporate geo-membranes to contain liquids. Although these low permeability liners have demonstrated excellent performance, they are susceptible to damage when drainage stone or alternate drainage media (such as shredded tires, crushed glass, etc) are placed over them. In addition, geo-membranes are prone to damage from isolated protrusions present in the sub-grade onto which they are deployed.

Geo-membranes are often used in civil engineering applications to create hydraulic barrier between two media. Their basic function is to remain impervious over the entire design life of the project. However, mechanical stresses induced by the confined materials could produce a deformation of the membrane and, in critical situations, could ultimately puncture it. Therefore, in any landfill project, properly protecting the geo-membrane from tearing or puncturing during construction is critical and of paramount importance.

Recent and ongoing research indicates that use of a properly selected non-woven, needle-punched geo-textile cushion adjacent to (above and/or below) a geo-membrane can effectively protect it from construction and operational damage in typical applications including solid waste landfills and liquid impoundments with varying load, sub-grade and cover sub-grade soil conditions.

Survivability is very important from the viewpoint of its long term durability and is defined as resistance to mechanical damage during construction and initial operation. The ability of a geo-synthetic to survive installation and use must be assured, if it is to perform as designed. Installation damage to a geo-textile is a function of the following:

- a) Geo-textile mass per square meter and thickness;
- b) Polymer used in the manufacture of geo-textile;
- c) Geo-textile manufacturing process (needle punching, chemical or thermal bonding);
- d) Condition of the sub-grade; and
- e) Drainage media.

In formulating this standard, considerable assistance has been derived from GRI Test Method — GT 12 (b) : 2008 Standard for 'Test methods and properties for non-woven geo-textiles used as protection (or cushioning) materials (*Revision 1*)' published by the Geo-synthetic Research Institute, USA.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GEO-SYNTHETICS — GEO-TEXTILES USED AS PROTECTION (OR CUSHIONING) MATERIALS — SPECIFICATION

1 SCOPE

1.1 This standard specifies requirements for needle-punched non-woven geo-textiles used as protection (or cushioning) materials adjacent to (above and/or below) a geo-membrane to protect it from construction and operational damage in typical applications including solid waste landfills and liquid impoundments with varying load, sub-grade and cover sub-grade soil conditions.

NOTE — The typical use shall be as a protective covering or underlayment of a geo-membrane against puncture or tear due to rock, stones, concrete or other hard surfaces and/or objects.

1.2 This standard covers physical, mechanical and endurance properties that must be met, or exceeded by the geo-textile.

1.3 This is a material purchasing specification and design review of its use for intended applications is recommended. This is not a construction or design specification. Protection (cushioning) of geo-membranes is a site specific design issue which should be addressed by the engineers responsible for the site design.

1.4 This standard is based on the minimum requirements of the geo-textile to provide tensile reinforcement and survivability from installation stress. In general, the geo-textile shall be placed at the proper elevation, location and orientation as detailed on the plans and specification.

1.5 The design, installation and construction guidelines for such geo-textiles are being published as a separate Indian Standard.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the definitions given

in IS 13321 (Part 1) and the following shall apply.

3.1 Minimum Average Roll Value (MARV) — For geo-synthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser shall have a 97.7 percent confidence that the property in question shall meet published values. For normally distributed data, MARV is calculated as the typical value minus two standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

4 REQUIREMENTS

4.1 A non-woven geo-textile shall be used as a protection (or cushioning) material for protecting geo-membranes from construction and operational damage in typical applications including solid waste landfills and liquid impoundments with varying load, sub-grade and cover sub-grade soil conditions.

NOTE — Normally needle-punched non-wovens geo-textiles shall be used; heat bonded and chemical bonded (resin dipped) geo-textiles (or others) may also be used.

4.2 Geo-synthetic materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties. Materials required for complete and proper installation of geo-synthetic materials that are not specifically described herein (such as pins, nails, washers, etc) shall conform to the manufacturer's recommendations and be as selected and supplied by the contractor subject to final approval by the engineer.

4.3 Polymers used in the manufacture of geo-textiles, and the mechanical fasteners or threads used to join adjacent rolls, shall consist of long chain/staple fibres of synthetic polymers, composed of at least 95 percent by weight of polyolefins (polypropylene, polyethylene) or polyesters. They shall be formed into a stable network such that the ribs, filaments or yarns retain their dimensional stability relative to each other, including selvages. Geo-textile materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

Polyolefin material shall be made resistant to ultraviolet light by adding 2-3 percent carbon black.

4.4 The geo-textiles shall be dimensionally stable and able to retain their geometry under manufacture, transport, and installation. The finished geo-textile shall have good appearance qualities. It shall be free from such defects that would affect the specific properties of the geo-textile, or its proper functioning. The geo-textiles used for protection (or cushioning) shall conform to the physical requirements as specified in Table 1.

4.5 The property values given in Table 1 represent default values which provide for sufficient separation function and survivability of geo-textile under most construction conditions.

4.6 All property values in these specifications represent minimum average roll values (MARV) (average value minus two standard deviations). Average of test results from any sampled roll in a lot shall meet or exceed the minimum values specified in Table 1.

5 MARKING AND LABELLING

5.1 The geo-textile material shall be marked with the following by attaching the printed labels:

- Identification of the geo-textile material as per manufacturer's recommendation, for example, polyester needle-punched non-woven geo-textile for protection;
- Mass of the geo-textile used, in g/m²;
- Batch number, lot number and roll number;
- Date and year of manufacture;
- Any other information/instruction provided by the manufacturer;
- Manufacturer's name, initials or trade-mark; and
- Country of origin.

5.2 BIS Certification Marking

The geo-textiles may also be marked with the Standard Mark.

5.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of India Standards.

6 SAMPLING AND CRITERIA FOR CONFORMITY

6.1 Lot

The quantity of the same class of geo-textile manufactured from the same polymer under identical conditions and supplied to a buyer in one shipment or one truckload, whichever is smaller, shall constitute a lot.

6.2 Sampling for testing shall be in accordance with IS 14706. Acceptance shall be based on testing of either conformance samples obtained using procedure A of IS 14706 or based on manufacturer's certification and testing of quality assurance samples obtained using Procedure B of IS 14706.

6.3 Testing of samples shall be performed in accordance with the methods referred in this standard for the indicated application. The number of test specimens recommended for testing is specified in each test method. Geo-textile product acceptance shall be determined by comparing the average test results of all specimen within a given sample to the specified MARV.

6.4 Criteria for Conformity

The geo-textile shall be tested for all the requirements as specified in Table 1 and according to **4.1** to **4.6**. When any individual sample fails to meet any of the specification requirements, the roll shall be rejected and two additional sample rolls shall be selected from the same lot. When either of these two additional samples fails to comply with any part of this standard, the entire quantity of rolls represented by that sample shall be rejected.

Table 1 Requirements for Geo-textiles Used as Geo-membrane Protection (or Cushioning) Materials
(Clauses 4.4, 4.5, 4.6 and 6.4)

Sl No. (1)	Property (2)	Requirement (3)						Method of Test, Ref to (4)
		I	II	III	IV	V	VI	
i)	Mass per unit area, g/m ²	300	400	600	800	1 000	1 200	IS 14716 / ISO 9864
ii)	Tensile strength, kN/m	16	21	27	32	36	45	IS 13162 (Part 5)
iii)	Trapezoidal tear strength, kN	0.42	0.51	0.66	0.89	0.96	1.32	IS 14293
iv)	CBR puncture resistance, kN	3.0	3.5	4.0	5.0	7.5	11.0	IS/ISO 12236
v)	Maximum UV resistance (after 500 h exposure), percent	70	70	70	70	70	70	IS 13162 (Part 2)

7 PACKING

The geo-textile shall be packed in rolls as per the contract or order. Each roll of geo-textile shall be protected by wrapping it in a LDPE film of minimum thickness of 40 μ to prevent it from the adverse impact of heat and moisture, sunlight, oil, grease, dirt, dust and other stains/contaminants during shipment and storage prior to deployment.

8 INFORMATION AND SAMPLES TO BE SUBMITTED BY THE MANUFACTURER

The manufacturer shall submit to the purchaser the following:

- a) Geo-textile product sample approximately 1 m² or larger;
- b) Geo-textile product data sheet and certification from himself stating that the geo-textile product supplied meets the requirements of this standard; and
- c) Manufacturer's installation instructions and general recommendations.

9 IDENTIFICATION, DELIVERY, STORAGE AND HANDLING

9.1 Identification

The geo-textile material shall be identified by the microscopic and confirmatory chemical tests prescribed in IS 667. Product labels shall clearly show the manufacturer's or supplier's name, batch number, lot number and roll number. Each shipping document shall include documentation certifying that the material is in compliance with this standard.

9.2 Site Unloading

Unload the geo-textile fabric at site by using a fork — lift or front — end loader fitted with a long, tapered pole. This pole is inserted into the geo-textile roll core and the roll is lifted off the truck bed. The pole shall be long enough to extend at least two-third of the way into the geo-textile roll core to avoid the possibility of breaking or damaging the roll core. Geo-textile rolls may also be lifted from flatbed trailers using nylon straps or rope and a crane, backhoe or bulldozer. No more than three geo-textile rolls shall be lifted at a time. Exceeding this number may cause damage to the roll core and hamper geo-textile deployment. Chains and cables shall not be used to lift the geo-textile rolls. When these equipment are not available at site, other locally available methods can be used for unloading. If unloaded with care, the geo-textile shall remain suitable for laying. A roll puller, nylon strap, or rope can be used to unload geo-textile rolls from an enclosed trailer by inserting into

the roll core and dragging the roll to the edge of the truck bed and down to the ground surface. Nylon straps or ropes may also be wrapped around the geo-textile roll using a slipknot. Again the roll is dragged to the edge of the truck and down to the ground surface. A tarpaulin, sheet of plastic or fabric should be placed on the ground where the geo-textile rolls are to be unloaded.

9.3 Site Handling

Rolls of geo-textile shall always be lifted off the ground surface prior to moving. Dragging the geo-textile and operating equipment on the geo-textile, which results in physical damage, should be avoided all times.

9.4 Storage and Protection

9.4.1 The paving fabric shall be kept dry and wrapped such that it is protected from outside weather during shipping and storage. During storage, geo-textile rolls shall be elevated off the ground and adequately protected with a waterproof cover from the following:

- a) Site construction damage;
- b) Excessive precipitation;
- c) Extended exposure to sunlight;
- d) Aggressive chemicals (strong acids, bases, etc);
- f) Excessive mud, wet concrete, epoxy, or other deleterious materials coming in contact with and affixing to the geo-textile material;
- g) Flames including welding sparks;
- h) Temperatures in excess of 71°C; and
- j) Any other environmental condition that may damage the geo-textile.

NOTE — If the protective wrapping is damaged, proper storage of the geo-textile is particularly critical. If the outer layer of geo-textile itself is damaged, the damaged portion must be removed and discarded during installation. The outermost layer of geo-textiles may be needed to be removed when a roll is exposed to sunlight for a period beyond that recommended by the manufacturer.

9.4.2 Store the geo-textile paving fabric at temperatures above –20°C. The air and pavement temperatures shall be at least 10°C and that for asphalt cement/emulsion 16°C.

9.4.3 Lay the rolled materials flat or vertical on ends.

9.4.4 Do not leave the geo-textile material directly exposed to sunlight for a period longer than the period recommended by the manufacturer.

9.4.5 Each geo-textile roll shall be wrapped with a material that shall protect it from damage due to shipment, water, sunlight and contaminants.

9.4.6 Keep geo-textile dry until installation, and do not store directly on the ground.

9.4.7 If geo-textile rolls become wet, remove the waterproof cover to allow for a few days of exposure to wind in order to dry the fabric. It is essential that the rolls shall be elevated during the process. The protective wrapping from one end of the roll may also be removed and the opposite end of the roll be elevated which allows the majority of excess water to flow out of the geo-textile.

NOTES

1 In most cases, these procedures shall not allow the fabric to dry completely. Once unrolled during installation, the geo-textile shall dry quickly in the sun and wind. However, it should be noted that non-woven geo-textiles used in conjunction with bitumen overlays of existing pavements must be completely dry prior to installation.

2 Exposing geo-textile rolls to moisture or water prior to installation can lead to serious handling problems. Non-woven geo-textiles in particular, can absorb water up to three times their weight. In addition, the cores on which the geo-textile rolls are wound, are manufactured from laminating paper. When wet, the strength of these cores is seriously diminished to the point where the core shall not support the weight of the geo-textile. Consequently, it can be extremely difficult to install wet rolls of geo-textile. In addition, it is nearly impossible to unroll wet, frozen geo-textile without first allowing it to thaw.

9.4.8 Geo-textiles slowly degrade in the presence of ultraviolet light and shall be protected by stabilizing chemicals and limiting exposure to sunlight until just before installation depending upon the environmental conditions or as decided by the site engineer.

9.4.9 The geo-textile shall be installed within the period specified in the project specifications or, otherwise, the exposure is limited to a period of two weeks.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
667 : 1981	Methods for identification of textile fibres (<i>first revision</i>)	14293 : 1995	Geo-textiles — Method of test for trapezoid tearing strength
3162 (Part 2) : 1991	Geo-textiles — Methods of test: Determination of resistance to the exposure of ultraviolet light and water (Xenon-arc type apparatus)	14706 : 1999	Geo-textiles — Sampling and preparation of test specimens
(Part 5) : 1992	Determination of tensile properties using a wide width strip	14716 : 1999/ ISO 9864 : 1990	Geo-textiles — Determination of mass per unit area
13321 (Part 1) : 1992	Glossary of terms for geo-synthetics: Part 1 Terms used in materials and properties	IS/ISO 12236 : 2006	Geo-synthetics — Static puncture test (CBR test) (<i>under print</i>)

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